



Qazvin university of medical science  
Department of Immunology & Microbiology

# Journal Club & MSc Seminar

# HOSPITAL ACQUIRED INFECTION



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# Hospital-acquired infection (HAI)

## DEFINING A HAI

**HOSPITAL-ACQUIRED INFECTION (HAI)** — ALSO KNOWN AS **NOSOCOMIAL INFECTION** — IS AN INFECTION WHOSE DEVELOPMENT IS FAVORED BY A HOSPITAL ENVIRONMENT, SUCH AS ONE ACQUIRED BY A PATIENT DURING A HOSPITAL VISIT OR ONE DEVELOPING AMONG HOSPITAL STAFF.

# When you say hospital acquired infection

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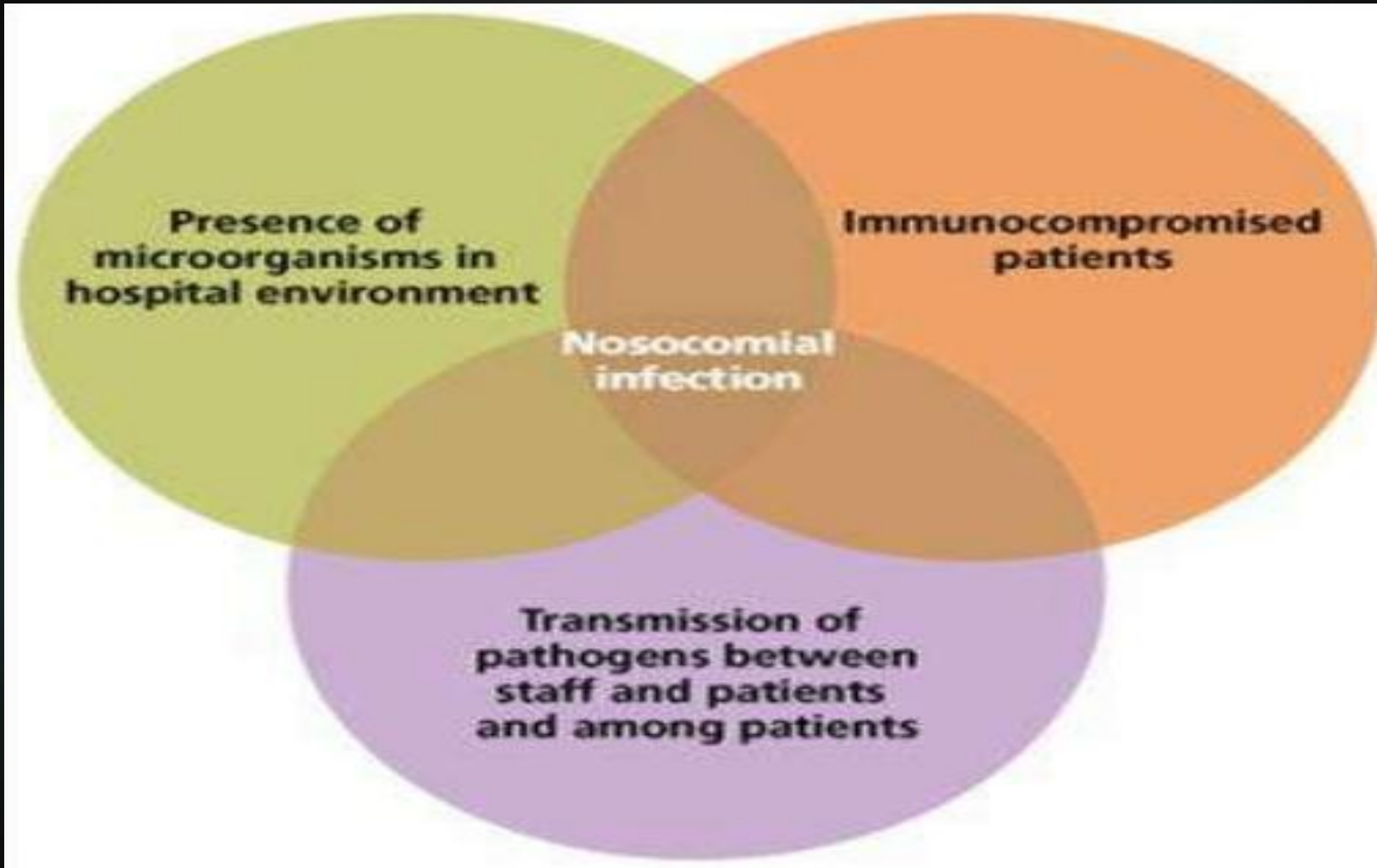
- ▶ Infection which was neither present nor incubating at the time of admission
- ▶ Includes infection which only becomes apparent after discharge from hospital but which was acquired during hospitalization.
- ▶ Infections are considered nosocomial if they first appear 48 hrs or more after hospital admission or within 30 days after discharge.

► **Infectoin**

- 1. Invasion by and multiplication of pathogenic microorganisms in a bodily part or tissue, which may produce subsequent tissue injury and progress to overt disease through a variety of cellular or toxic mechanisms.
- 2. An instance of being infected.
- 3. An agent or a contaminated substance responsible for one's becoming infected.
- 4. The pathological state resulting from having been infected.
- 5. An infectious disease.

► **Colonization**

- Infection begins when an organism successfully **colonizes by entering the body, growing and multiplying**. Most humans are not easily infected. Those who are weak, sick, malnourished, have cancer or are diabetic have increased susceptibility to chronic or persistent infections. Individuals who have a suppressed immune system are particularly susceptible to opportunistic infections



# EPIDEMIOLOGICAL INTERACTION

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- ▶ **HOST FACTORS**

- ▶ Suppressed immune system due to age , Poor nutritional status , severity of underlying disease, complicated diagnostic & therapeutic procedure, therapeutic

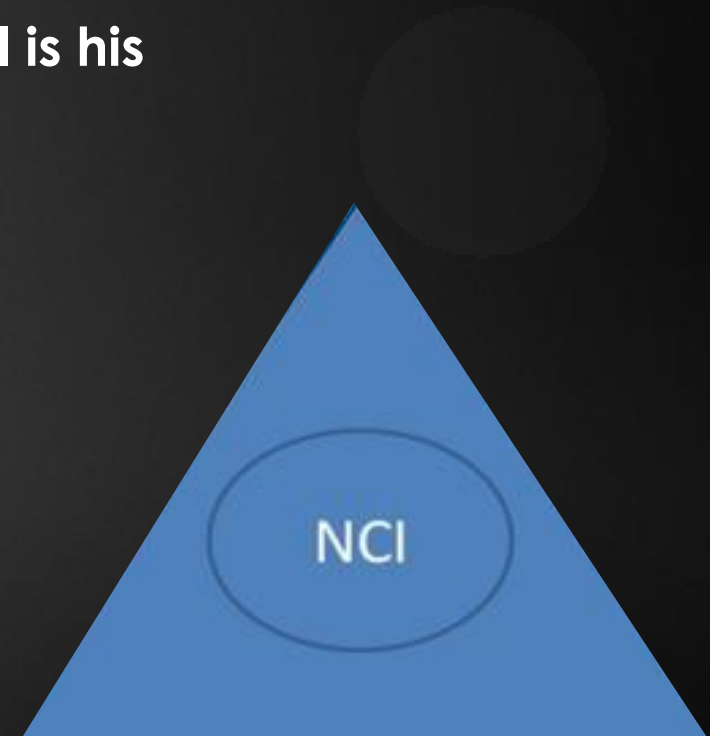
- ▶ **THE AGENT**

- ▶ Varieties of organisms
- ▶ Institutional & Human
- ▶ Reservoirs & Their virulence



# continue

- ▶ **THE ENVIRONMENT**
- ▶ Everything that surrounds the patient in the hospital is his environment
- ▶ Other patients
- ▶ Hospital staff and visitors
- ▶ Eatables
- ▶ Dust and other contaminated articles



# SOURCES OF HAI

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- ▶ 1) Patients own flora- Endogenous (50%)
  - ▶ Autoinfection ( Greatest source of potential danger )
- ▶ 2) Environment – Exogenous (15%)
  - ▶ Air- 5%
  - ▶ Instruments – 10%
- ▶ 3) Another Patient/Staff-Cross Infection (35%)

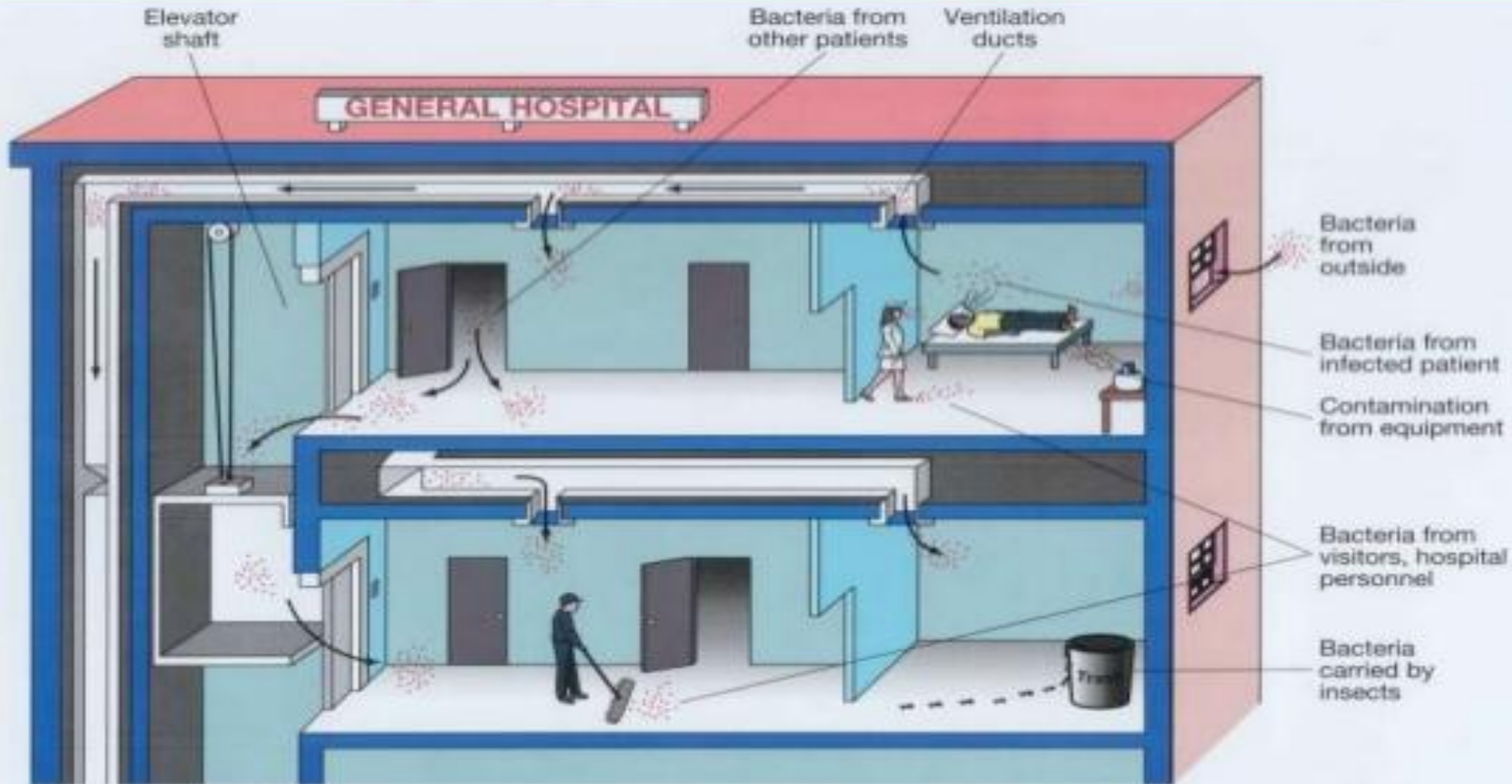


# Sources of Hospital-Acquired Infections



# EXOGENOUS INFECTION SITES

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## ***The Inanimate Environment Can Facilitate Transmission***

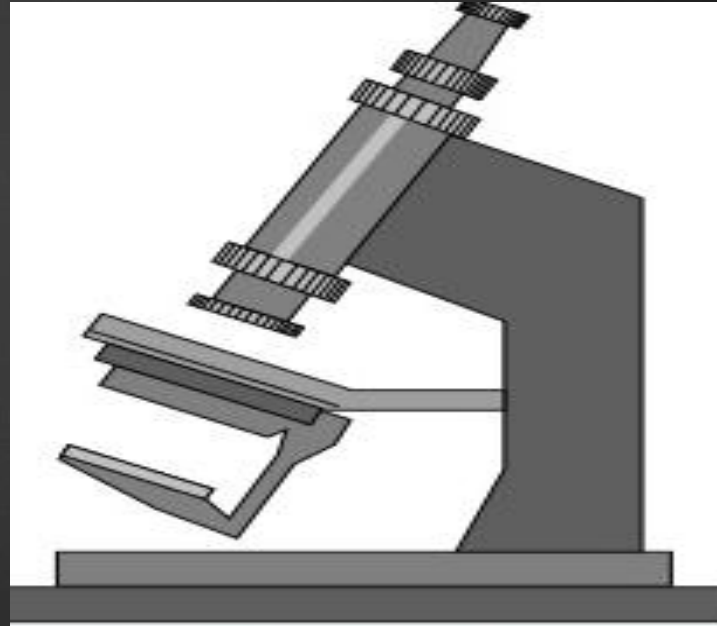


- Contaminated surfaces increase cross-transmission

# Exogenous Pathogens

## All microorganisms can cause nosocomial infections

- ▶ Viruses
- ▶ Bacteria
- ▶ Fungi
- ▶ Parasites



# HAI – COMMON BACTERIA

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- ▶ **Gram +**

- ▶ *Staphylococcus epidermidis*
- ▶ *Staphylococcus aureus*

- ▶ **Gram –**

- ▶ *Enerobacteriaceae*
- ▶ *Pseudomonas aeruginosa*
- ▶ *Acinetobacter baumannii*
- ▶ *Mycobacterium tuberculosis*



## **CDC** ESTIMATES MAJOR INFECTIONS ARE CAUSED COMMON MICROBES

- According to the CDC, the most common pathogens that cause nosocomial infections are *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *E. coli*. Some of the common nosocomial infections are urinary tract infections, respiratory pneumonia, surgical site wound infections, bacteremia, gastrointestinal and skin infections.

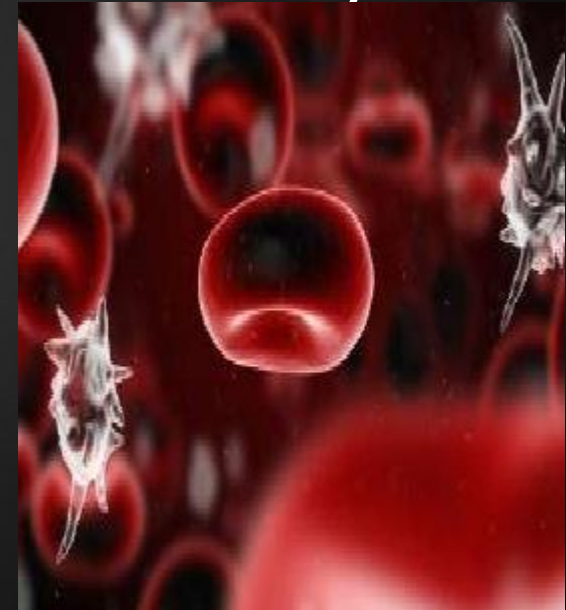




# HAI- COMMON VIRUSES & FUNGI

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- ▶ **Blood born infection :**
  - ▶ **Hepatitis A** – infectious hepatitis
  - ▶ **Hepatitis B** – serum hepatitis
  - ▶ **Human immunodeficiency virus [ HIV ]** – acquired immunodeficiency syndrome [ AIDS ]
  - ▶ **Others :** rubella , varicella , SARS
- 
- ▶ **Candida**
  - ▶ **Aspergillus**



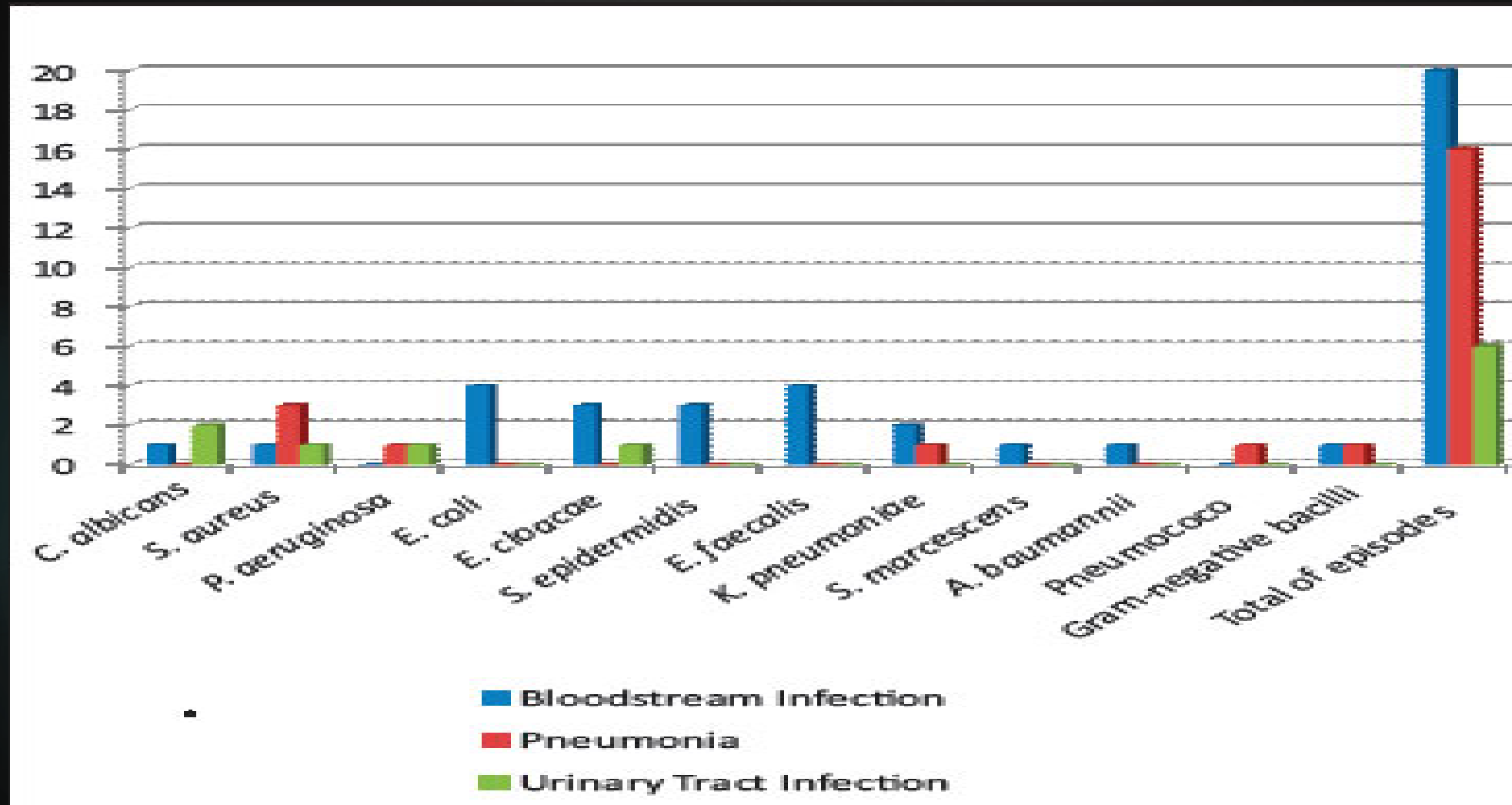
# TYPES OF INFECTIONS

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- ▶ Urinary tract infection (UTI)
- ▶ Surgical wound infections (SWI)
- ▶ Lower respiratory infection
- ▶ Traumatic wounds and burns infections
- ▶ Primary bacteraemia
- ▶ Gastrointestinal tract
- ▶ Central nervous system
- ▶ **Most common sites for nosocomial infections:**
- ▶ **UTI**
- ▶ **SWI**
- ▶ **Lower respiratory tract**
- ▶ **Blood stream (i.e., catheter – related )**

# Major Types Nosocomial Infections

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# Transmission

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- ▶ Contact transmission
- ▶ The most important and frequent mode of transmission of nosocomial infections is by direct contact.
- ▶ Droplet transmission
- ▶ Transmission occurs when droplets containing microbes from the infected person are propelled a short distance through the air and deposited on the host's body; droplets are generated from the source person mainly by coughing, sneezing, and talking, and during the performance of certain procedures, such as bronchoscopy.
- ▶ Airborne transmission
- ▶ Dissemination can be either airborne droplet nuclei (small-particle residue {5  $\mu\text{m}$  or smaller in size} of evaporated droplets containing microorganisms that remain suspended in the air for long periods of time) or dust particles containing the infectious agent. Microorganisms carried in this manner can be dispersed widely by air currents and may become inhaled by a susceptible host within the same room or over a longer distance from the source patient, depending on environmental factors; therefore, special air-handling and ventilation are required to prevent airborne transmission. Microorganisms transmitted by airborne transmission include *Legionella*, *Mycobacterium tuberculosis* and the rubeola and varicella viruses.

# continue

- ▶ Common vehicle transmission
- ▶ This applies to microorganisms transmitted to the host by contaminated items, such as food, water, medications, devices, and equipment.
- ▶ Vector borne transmission
- ▶ This occurs when vectors such as mosquitoes, flies, rats, and other vermin transmit microorganisms.
- ▶ Blood born
- ▶ hospitals should include prevention programs to reduce exposure to blood and body fluids, including the use of safety-engineered devices.
- ▶ All blood specimens or body fluids must be placed in leak-proof impervious bags for transportation to the laboratory.

# continue

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## ► Direct-contact transmission

- This involves a direct body surface-to-body surface contact and physical transfer of microorganisms between a susceptible host and an infected or colonized person, such as when a person turns a patient, gives a patient a bath, or performs other patient-care activities that require direct personal contact. Direct-contact transmission also can occur between two patients, with one serving as the source of the infectious microorganisms and the other as a susceptible host.

## ► Indirect-contact transmission

- This involves contact of a susceptible host with a contaminated intermediate object, usually inanimate, such as contaminated instruments, needles, or dressings, or contaminated gloves that are not changed between patients. In addition, the improper use of saline flush syringes, vials, and bags has been implicated in disease transmission in the US, even when healthcare workers had access to gloves, disposable needles, intravenous devices, and flushes.





# The hands are the most important vehicle of transmission of HCAI

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# Hand Hygiene Techniques

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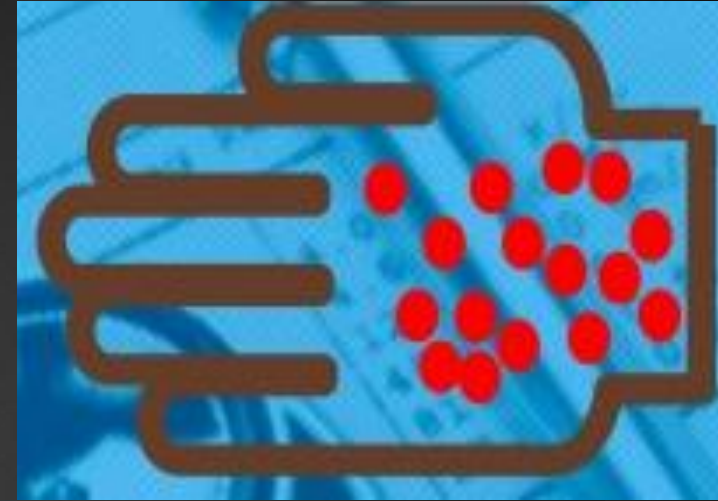
- ▶ 1) Alcohol hand rub
- ▶ 2) Routine hand wash 10-15 seconds
- ▶ 3) Aseptic procedures 1 minute
- ▶ 4) Surgical wash 3-5 minutes

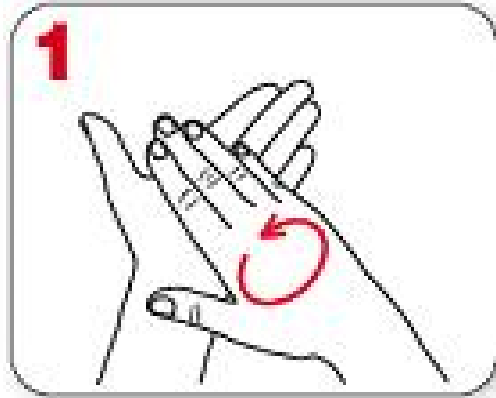


# Hand Care

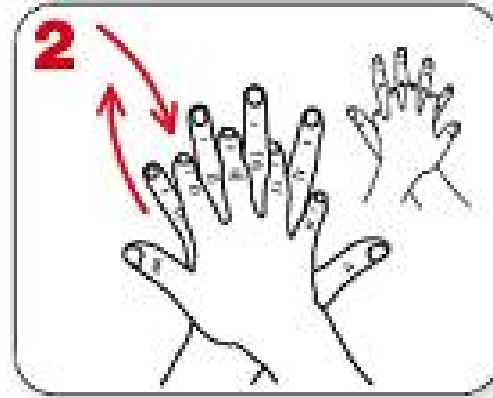
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- ❑ Nails
  - ❑ Rings
  - ❑ Hand cream
  - ❑ Cuts & abrasions
  - ❑ Chapping
  - ❑ Skin problems
- 
- ❑ Hand hygiene is the simplest , most effective measure for preventing hospital – acquired infections.

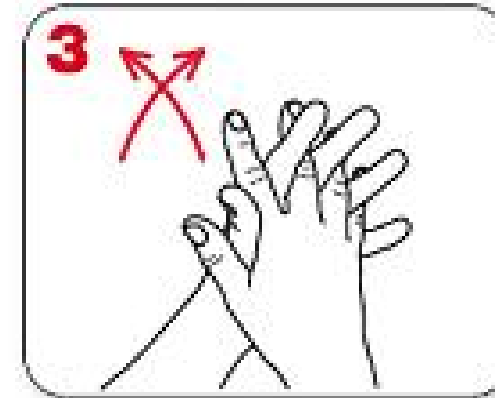




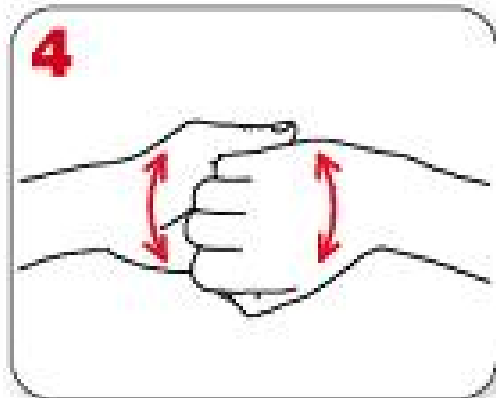
Rub hands palm to palm



right palm over left dorsum with interlaced fingers and vice versa



palm to palm with fingers interlaced



backs of fingers to opposing palms with fingers interlocked



rotational rubbing of left thumb clasped in right palm and vice versa



rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa



# 1 BEFORE PATIENT CONTACT

**WHEN?** Clean your hands before touching a patient when approaching him or her

**WHY?** To protect the patient against harmful germs carried on your hands

# 2 BEFORE AN ASEPTIC TASK

**WHEN?** Clean your hands immediately before any aseptic task

**WHY?** To protect the patient against harmful germs, including the patient's own germs, entering his or her body

# 3 AFTER BODY FLUID EXPOSURE RISK

**WHEN?** Clean your hands immediately after an exposure risk to body fluids (and after glove removal)

**WHY?** To protect yourself and the health-care environment from harmful patient germs

# 4 AFTER PATIENT CONTACT

**WHEN?** Clean your hands after touching a patient and his or her immediate surroundings when leaving

**WHY?** To protect yourself and the health-care environment from harmful patient germs

# 5 AFTER CONTACT WITH PATIENT SURROUNDINGS

**WHEN?** Clean your hands after touching any object or furniture in the patient's immediate surroundings, when leaving - even without touching the patient

**WHY?** To protect yourself and the health-care environment from harmful patient germs





ELSEVIER

Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

# American Journal of Infection Control

journal homepage: [www.ajicjournal.org](http://www.ajicjournal.org)



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## Major article

### Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional approach in 3 cities in Brazil

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**Background:** Hand hygiene (HH) is the main tool for cross-infection prevention, but adherence to guidelines is low in limited-resource countries, and there are not available published data from Brazil.

**Methods:** This is an observational, prospective, interventional, before-and-after study conducted in 4 intensive care units in 4 hospitals, which are members of the International Nosocomial Infection Control Consortium (INICC), from June 2006-April 2008. The study was divided into a 3-month baseline period and a follow-up period. A multidimensional HH approach was introduced, which included administrative support, supplies availability, education and training, reminders in the workplace, process surveillance, and performance feedback. Health care workers were observed for HH practices in each intensive care unit during randomly selected 30-minute periods.

**Results:** We recorded 4,837 opportunities for HH, with an overall HH compliance that increased from 27%-58% ( $P < .01$ ). Multivariate analysis showed that some variables were associated with poor HH compliance: men versus women (49% vs 38%,  $P < .001$ ), nurses versus doctors (55% vs 48%,  $P < .02$ ), among others.

**Conclusions:** With the implementation of the INICC approach, adherence to HH was significantly increased. Programs should be aimed at improving HH in variables found to be predictors of poor HH compliance.

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# PREVENTION AND CONTROL

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- ▶ ISOLATION
- ▶ Designed to prevent transmission of microorganisms by common routes in hospitals. Because agent and host factors are more difficult to control , interruption of transfer of microorganisms is directed primarily at transmission.
- ▶ Sterilization
- ▶ sterilization of all reusable equipments such as ventilator , humidifier and any device that come in contact with the respiratory tract.



- ▶ **Wear Gloves**
- ▶ They are worn for two reasons :
  - ▶ Provide a protective barrier and prevent contamination of hands
  - ▶ Reduce the likelihood that microorganism present on the hands will be transmitted to the patients during invasive and other patient care procedure.
- ▶ **Tell your doctor everything**
  - ▶ 1. All symptoms
  - ▶ 2. Previous disease
  - ▶ 3. Other alternative treatment
  - ▶ 4. Other over the counter medication





► **Wear Aprons**

- Wearing an apron during patient care reduces the risk of infections.
- Apron is must for preventing yourself from getting disease.

► **Get educated**

- Learn about your conditions and treatment is the best way to prevent an error.

► **Get involved**

- Be assertive about your rights
- To be a part of the decision
- Process for your medical care



- ▶ **Surveillance**
- ▶ Surveillance for common infections , monitoring of high risk patients , and hospital area to identify outbreaks , document incidence and prevalence rate of specific infection and set goal for improvement.
- ▶ Surveillance = key factor
- ▶ an infection control measure
- ▶ overview of the burden and distribution of NCI
- ▶ allocate preventive resources
- ▶ Surveillance is cost – efficient !!

# Objectives

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- ▶ Reducing infection rates
- ▶ Establishing endemic baseline rates
- ▶ Identifying risk factors
- ▶ Persuading medical personnel
- ▶ Evaluate control measures
- ▶ Satisfying regulators
- ▶ Document quality of care
- ▶ Compare hospitals NCI rates



# The Surveillance Loop

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# control

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- ▶ There are **three principal goals** for hospital infection control and prevention programs :
- ▶ 1. Protect the patients
- ▶ 2. Protect the health care workers , visitors , and others in the healthcare environment.
- ▶ 3. Accomplish the previous two goals in a cost effective and cost efficient manner , whenever possible.

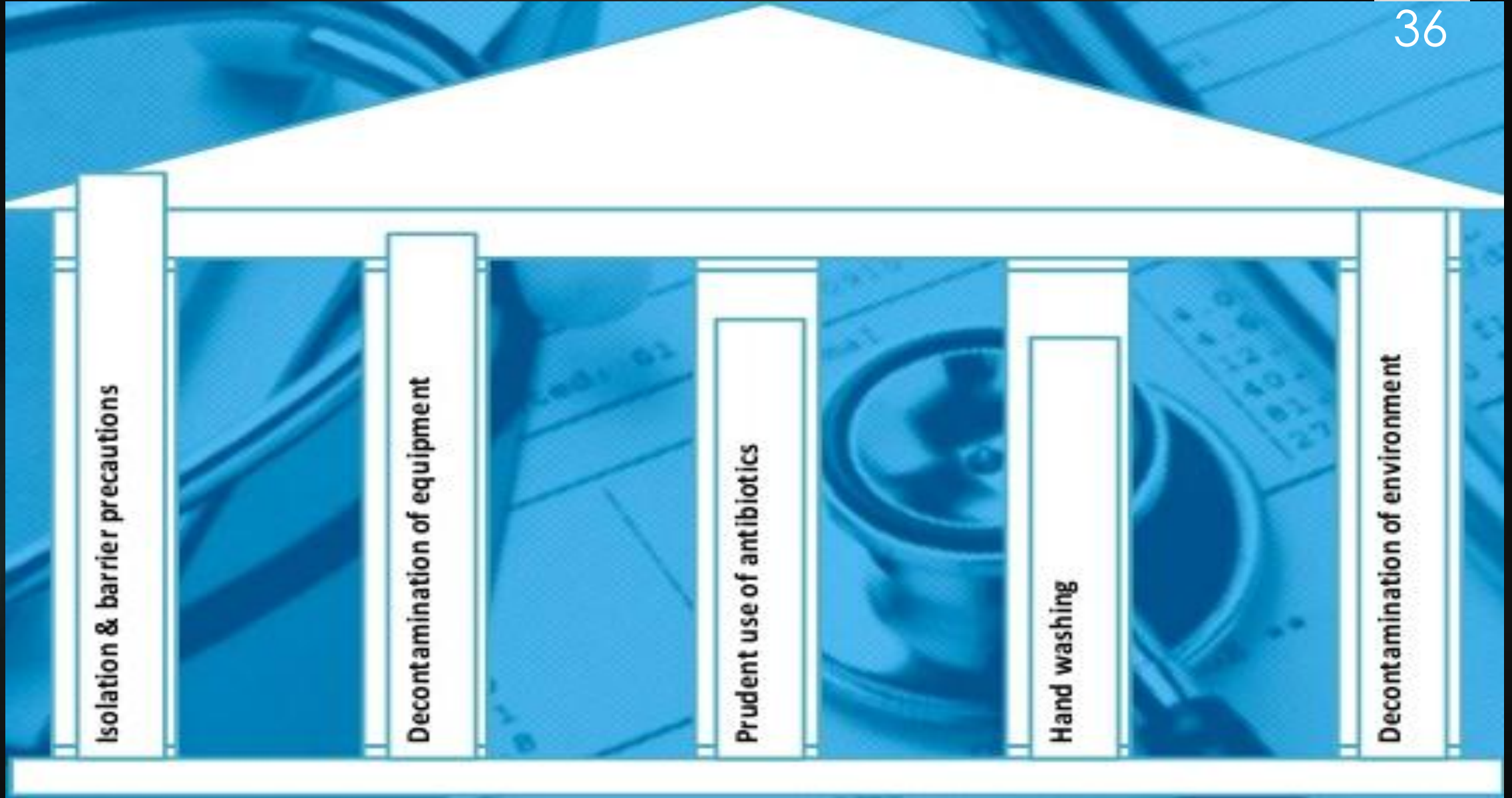
# Spaulding Classification

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- ▶ In 1972, Dr. Earl Spaulding<sup>5</sup> proposed a system for classifying liquid chemical germicides and inanimate surfaces that has been used subsequently by CDC, FDA, and opinion leaders in the United States. This system, as it applies to device surfaces, is divided into three general categories based on the theoretical risk of infection if the surfaces are contaminated at time of use. From the laboratory perspective, these categories are:
- ▶ **critical**—instruments or devices that are exposed to normally sterile areas of the body require sterilization.
- ▶ **semi-critical**—instruments or devices that touch mucous membranes may be either sterilized or disinfected.
- ▶ **non-critical**—instruments or devices that touch skin or come into contact with persons only indirectly can be either cleaned and then disinfected with an intermediate-level disinfectant, sanitized with a low-level disinfectant, or simply cleaned with soap and water.

# The 5 pillars of infection control

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# Infection Control Committee

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# Infection Control Committee (ICC)

- ▶ The hospital ICC is charged with the responsibility for the planning , evaluation of evidenced-based practice and implementation , prioritization and resource allocation of all matters relating to infection control.
- ▶ This committee should meet regularly and publish the results of their surveillance. At the same time , healthcare institutions should adopt new and better technology , like closed system IV fluids , in order to reduce the rates of infections.

Further, training the paramedical staff on various aspects of HAIs and measures of infection prevention will help tremendously in reducing the morbidity & mortality resulting from nosocomial infections.

# Infection Control Team

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- **Doctors**
  - General physician
  - Infectious disease specialist
  - Surgeon
  - Clinical microbiologist
- **Infection control nurse**
- **Representatives from other relevant departments**
  - Laboratory
  - Housekeeping
  - Pharmacy and central supply
  - Administration



# Role of infection control teams

- Addressing food handling, laundry handling, cleaning procedures, visitation policies, and direct patient care practices
- Obtaining and managing critical bacteriological data and information, including surveillance data
- Developing and recommending policies and procedures pertaining to infection control
- Recognizing and investigating outbreaks of infections in the hospital and community
- Intervening directly to prevent infections
- Educating and training health care workers, patients, and nonmedical caregivers

# Role of the microbiology laboratory

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- ▶ Identification of pathogens
- ▶ Provision of advice on antimicrobial therapy
- ▶ Provision of advice on specimen collection and transport
- ▶ Periodic reporting of hospital infection data and antimicrobial resistance
- ▶ Identification of sources and mode of transmission of infection
- ▶ Provide training for personnel involved in infection control



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## Targeted versus Universal Decolonization to Prevent ICU Infection

Susan S. Huang, M.D., M.P.H., Edward Septimus, M.D., Ken Kleinman, Sc.D., Julia Moody, M.S., Jason Hickok, M.B.A., R.N., Taliser R. Avery, M.S., Julie Lankiewicz, M.P.H., Adrijana Gombosov, B.S., Leah Terpstra, B.A., Fallon Hartford, M.S., Mary K. Hayden, M.D., John A. Jernigan, M.D., Robert A. Weinstein, M.D., Victoria J. Fraser, M.D., Katherine Haffenreffer, B.S., Eric Cui, B.S., Rebecca E. Kaganov, B.A., Karen Lolans, B.S., Jonathan B. Perlin, M.D., Ph.D., and Richard Platt, M.D., for the CDC Prevention Epicenters Program and the AHRQ DECIDE Network and Healthcare-Associated Infections Program\*

### ABSTRACT

#### BACKGROUND

Both targeted decolonization and universal decolonization of patients in intensive care units (ICUs) are candidate strategies to prevent health care–associated infections, particularly those caused by methicillin-resistant *Staphylococcus aureus* (MRSA).

#### METHODS

From the University of California Irvine School of Medicine, Orange (S.S.H., A.G., L.T., E.C.); Hospital Corporation of America, Houston (E.S.) and Nashville (J.M., J.H., J.B.P.); Texas A&M Health Science



## BACKGROUND

Both targeted decolonization and universal decolonization of patients in intensive care units (ICUs) are candidate strategies to prevent health care–associated infections, particularly those caused by methicillin-resistant *Staphylococcus aureus* (MRSA).

## METHODS

We conducted a pragmatic, cluster-randomized trial. Hospitals were randomly assigned to one of three strategies, with all adult ICUs in a given hospital assigned to the same strategy. Group 1 implemented MRSA screening and isolation; group 2, targeted decolonization (i.e., screening, isolation, and decolonization of MRSA carriers); and group 3, universal decolonization (i.e., no screening, and decolonization of all patients). Proportional-hazards models were used to assess differences in infection reductions across the study groups, with clustering according to hospital.

## RESULTS

A total of 43 hospitals (including 74 ICUs and 74,256 patients during the intervention period) underwent randomization. In the intervention period versus the baseline period, modeled hazard ratios for MRSA clinical isolates were 0.92 for screening and isolation (crude rate, 3.2 vs. 3.4 isolates per 1000 days), 0.75 for targeted decolonization (3.2 vs. 4.3 isolates per 1000 days), and 0.63 for universal decolonization (2.1 vs. 3.4 isolates per 1000 days) ( $P=0.01$  for test of all groups being equal). In the intervention versus baseline periods, hazard ratios for bloodstream infection with any pathogen in the three groups were 0.99 (crude rate, 4.1 vs. 4.2 infections per 1000 days), 0.78 (3.7 vs. 4.8 infections per 1000 days), and 0.56 (3.6 vs. 6.1 infections per 1000 days), respectively ( $P<0.001$  for test of all groups being equal). Universal decolonization resulted in a significantly greater reduction in the rate of all bloodstream infections than either targeted decolonization or screening and isolation. One bloodstream infection was prevented per 99 patients who underwent decolonization. The reductions in rates of MRSA bloodstream infection were similar to those of all bloodstream infections, but the difference was not significant. Adverse events, which occurred in 7 patients, were mild and related to chlorhexidine.

## CONCLUSIONS

In routine ICU practice, universal decolonization was more effective than targeted decolonization or screening and isolation in reducing rates of MRSA clinical isolates and bloodstream infection from any pathogen. (Funded by the Agency for Healthcare Research and the Centers for Disease Control and Prevention; REDUCE MRSA Clinical Trial; <http://www.clinicaltrials.gov>; NCT00999999.)

# Related Studies

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- ▶ 1- Pollack, Andrew. "Rising Threat of Infections Unfazed by Antibiotics"  
New York Times, Feb. 27, 2010
- ▶ 2- Jain SK, Persaud D, Perl TM et al. (July 2005). "Nosocomial malaria and saline flush". *Emerging Infect. Dis.* **11** (7): 1097–9.  
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